

Scientists Make First-Ever Observations Of Comet's Demise Deep Inside Solar Atmosphere

PALO ALTO, Calif., Jan. 19, 2012 /PRNewswire/ -- In a paper to be published tomorrow in the journal *Science*, for the first time ever scientists at the Lockheed Martin (NYSE: LMT) Solar and Astrophysics Laboratory (LMSAL) at the Advanced Technology Center (ATC) in Palo Alto, and collaborators at other institutions, have reported observations and analysis of the final death throes of a comet, as it passed across the face of the Sun on July 6, 2011, to vanish in flight.

Using observations from the Atmospheric Imaging Assembly (AIA) instrument on board NASA's Solar Dynamics Observatory (SDO), the comet was first seen about 0.2 solar radii off the limb of the Sun, travelling at nearly 400 miles per second and was tracked for 20 minutes until it disintegrated and evaporated in the low solar corona, about 62,000 miles above the solar surface. The Extreme-Ultraviolet Imager (EUVI), on one of NASA's twin Solar-Terrestrial Relations Observatories (STEREO), made simultaneous additional observations of the comet's passage from its near-quadrature view relative to the Sun-Earth line.

The comet was discovered on July 4, 2011 by using the Large Angle and Spectrometric Coronagraph (LASCO) on the ESA/NASA Solar and Heliospheric Observatory (SOHO), and was designated comet C/2011 N3 (SOHO). It was the SOHO discovery that alerted Lockheed Martin scientists to watch the AIA data stream for the comet's likely transit across the face of the Sun.

"This unprecedented passage of a comet through the solar atmosphere in view of our AIA cameras presented us with a remarkable opportunity," said LMSAL solar physicist Dr. Karel Schrijver, lead author of the *Science* paper and AIA principal investigator. "As we witnessed this comet evaporate as it traversed a known amount of space over a specific period of time, we were able to work backward to estimate its mass just before it reached the Sun. We've been able to bracket its size as between 150 and 300 feet long, with a greater likelihood that it lies at the upper end of that range. And it most likely weighed in at as much as 70,000 tons, giving it about the weight of an aircraft carrier, when it first became visible to AIA."

As the comet streaked into the solar atmosphere it had already fractured into many large pieces ranging in size from 30 to 150 feet. The pieces were embedded in the nebulous envelope made up of ice, dust, and gas called the coma, surrounding the comet's nucleus. The coma was estimated to be about 800 miles across, followed by a glowing tail approximately 10,000 miles long. The tail was seen pulsing from dim to bright to dim again during the journey across the Sun, which suggests that there was further breakup of the individual chunks of comet as it continued to fragment in the intense glow from the Sun's surface. Eventually, the comet evaporated completely.

"I think the light pulses in the tail were one of the most interesting things we witnessed," said Schrijver. "The comet's tail gets brighter by as much as four times every minute or two. The comet seems first to put a lot of material into that tail, then less, and then the pattern repeats. Only because of these pulses can we measure how fast the tail falls behind the comet as its gases collide with those in the Sun's atmosphere. And that, in turn, helps us measure the comet's weight."

During its 15 years of observations, the LASCO instrument on SOHO has observed more than 2000 comets as they approached the Sun. The population of these Sun-grazing comets is dominated by the Kreutz group, whose members orbit to within one to two solar radii from the solar surface (photosphere) every 500 to 1000 years. More than 1400 of the comets seen by SOHO are members of the Kreutz group, making it the largest known group of comets, likely originating from the breakup of a progenitor body as recently as 2500 years ago. Only the largest of the Kreutz group comets, with diameters of up to about 330 feet have survived perihelion – their closest approach to the Sun.

Prior to the observations reported in *Science*, cometary masses were generally derived from lightcurves during their orbits, assumed reflectivity, and estimated mass densities, or by direct imaging for the few comets that have been visited by spacecraft. LASCO observes a Sun-grazing comet roughly once every three days, and while most fade well before perihelion, several per year should reach the solar corona and be available for further study of cometary properties as well as probes of the solar corona.

The Solar and Astrophysics Laboratory at the ATC conducts basic research into understanding and predicting space weather and the behavior of our Sun, including its impacts on Earth and climate. It has a 48-year-long

heritage of spaceborne solar instruments including the Soft X-ray Telescope on the Japanese Yohkoh satellite, the Michelson Doppler Imager on the ESA/NASA Solar and Heliospheric Observatory, the solar telescope of NASA's Transition Region and Coronal Explorer, the Focal Plane Package on the Japanese Hinode satellite, the Solar X-ray Imagers on GOES-N, -O and -P, the Extreme Ultraviolet Imager instruments on NASA's twin STEREO spacecraft, and the Helioseismic and Magnetic Imager and the Atmospheric Imaging Assembly on NASA's Solar Dynamics Observatory. The ATC is currently building both the science instrument and spacecraft for NASA's Interface Region Imaging Spectrograph (IRIS), a Small Explorer Mission scheduled for launch in late 2012.

The ATC is the research and development organization of Lockheed Martin Space Systems Company (LMSSC). LMSSC, a major operating unit of Lockheed Martin Corporation, designs and develops, tests, manufactures and operates a full spectrum of advanced-technology systems for national security and military, civil government and commercial customers. Chief products include human space flight systems; a full range of remote sensing, navigation, meteorological and communications satellites and instruments; space observatories and interplanetary spacecraft; laser radar; ballistic missiles; missile defense systems; and nanotechnology research and development.

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